federal register

FRIDAY, SEPTEMBER 8, 1972
WASHINGTON, D.C.
Volume 37 ■ Number 175

PART II

ENVIRONMENTAL PROTECTION AGENCY

■

CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES AND ENGINES

Heavy Duty Engines

Title 40—PROTECTION OF ENVIRONMENT

Chapter I—Environmental Protection Agency

PART 85—CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES AND NEW MOTOR VEHICLE ENGINES

Heavy-Duty Engines

Emission standards and test procedures to be applicable to heavy duty gasoline and diesel motor vehicle engines beginning with the 1973 model year were proposed by the Environmental Protection Agency (EPA) on October 5, 1971 (36 F.R. 19400). On February 11, 1972, the Agency announced that, on the basis of comments received from domestic and foreign motor vehicle engine manufacturers and other interested parties, it had determined that there was inadequate leadtime available to apply the proposed standards and test procedures to the 1973 model year. The comments received also expressed objection to EPA adoption of a heavy duty engine test procedure significantly different from the procedure used by manufacturers for certification of motor vehicle engines to meet California standards because of the substantial costs involved in separate certifications. The California heavy-duty engine standards are in effect beginning with 1973, under the terms of a waiver of Federal preemption issued under section 209 of the Clean Air Act by the Administrator of EPA (36 F.R. 8172).

After evaluating the comments and all other information available to him, the Administrator has decided to promulgate the emission standards and test procedures set forth below applicable to heavy duty gasoline and diesel motor vehicle engines beginning with the 1974 model year. The standards are identical to those in effect in California beginning in 1973, except that the smoke emission regulations proposed in the October 5, 1971, publication have also been adopted. The test procedures being promulgated are essentially the 1973 California procedures, except for the following differences:

DIFFERENCES BETWEEN 1973/1974 CALIFORNIA AND RECOMMENDED FEDERAL 1974 REGULATIONS

Item	Federal requirement	California requirement
Diesel smoke standards	20 percent opacity during acceleration, 15 percent during lugging, 50 percent at peaks.	None.
Durability testing for gaseous emissions from diesels.	1,000 hrs.	Not specified.
Fuel requirements for emission data gasoline engines.	High octane leaded fuel	Low octane (91 max.).
Engine selection	Maximum of 4 emission data, 2 durability data engines.	More general than Federal specifications.
Fuel evaporative standard—heavy duty gasoline vehicles.	None [1]	2 gms/test.
Dynamometer time accumulation for emission data diesel engines.	125 hrs.	50 hrs.
Diesel fuel for emission data engines	Minimum 27 percent aromatics	No aromatic requirement.
Inlet air restrictions for emission data diesel engines.	Close to maximum seen in service	Less stringent.
Specification of load	Allows substitution of alternate loading when prescribed loading can not be attained.	Does not allow substitutions.
Number of dynamometer runs, separated by waiting period, for complete emission test for heavy duty diesel engines.	1 test run, with no waiting period [2]	2 test runs, separated by 8 hr. waiting period.

[1] Not feasible for Federal regulations since Federal certification is for the heavy duty engine whereas California certifies the heavy duty vehicle.
[2] EPA has no data available to indicate 2 test runs are necessary.

In the judgment of the Administrator, the emissions of hydrocarbons, carbon monoxide, nitrogen oxides, and smoke from heavy duty gasoline and diesel motor vehicle engines contribute to air pollution which endangers the public health and welfare. The regulations set forth below are intended to provide for significant reductions of emissions of these pollutants from levels currently allowed. The regulations on emissions of hydrocarbons, carbon monoxide, and nitrogen oxides from diesel engines would, in addition, provide a basis for judging low-emission vehicles under section 212 of the Clean Air Act.

It is also the Administrator's judgment that the regulations prescribed will provide approximately the same benefit in terms of air quality as those proposed October 5, 1971, since the regulations are of approximately the same stringency.

The Administrator has determined, after considering the cost of compliance, that the 1974 applicability date for these regulations provides reasonable opportunity for the development and application of the requisite technology. This determination is based upon the following factors:

a. Twenty-three of the 28 gasoline engines certified by EPA for the 1972 model year meet the 1973 California hydrocarbon standard; of the same 28 engines, 23 engines also meet the carbon monoxide standard, although these 23 are not the same 23 which meet the hydrocarbon standard;

b. All heavy-duty engines intended to be sold in California in 1973 must meet the California hydrocarbon, nitrogen oxides, and carbon monoxide standards, and certification tests run to date demonstrate successful development of control technology for compliance; and

c. Approximately 75 percent to 85 percent of the heavy-duty diesel engines certified for the 1972 model year already comply with the smoke emission standards prescribed below.

The Administrator has further determined that the cost to manufacturers of compliance with these regulations beginning with the 1974 model year will be minimized because the manufacturers will be able to obtain certification for California and the rest of the Nation by following the same test procedure, since only one fleet of test engines will be required.

In response to the October 5, 1971, proposal, engine manufacturers commented that there is insufficient data available to determine whether or not the humidity correction factor is correct. EPA agrees with this judgment. Data is currently being developed which will provide a basis for determining whether a change in the factor is necessary. If EPA determines that a change is necessary, it will be prescribed as soon as possible during 1972 and will be applicable beginning with the 1974 model year. Accordingly, the factor set forth in these regulations may be considered an interim measure.

Changes in the test procedures for smoke, which were not proposed, are as follows:

a. In response to manufacturers' comments on the proposal, the dynamometer operation cycle acceleration mode is clarified by specifying allowable deviation from a linear acceleration rate;

b. In response to manufacturers' comments on the proposal, the maximum exhaust system length is extended, which will facilitate testing without affecting test results;

c. In the smoke measurement system, the limits of the distance from optical centerline to exhaust pipe outlet have been narrowed to reflect the Agency's acknowledgment that no manufacturer has been testing at the current maximum distance;

d. An additional calibrated neutral density filter is prescribed to check instruments in order to accommodate the smoke standard being adopted; and

e. In the provision on test runs, the Agency determined that it is necessary to specify the limits of a valid test as regards drift.

Amendments to the heavy duty engine regulations applicable beginning with the 1973 model year are also set forth below. They consist of the following items:

a. Expansion of the definition of "useful life" to include 1,500 hours of operation (along with 5 years or 50,000 miles) for gasoline engines and 3,000 hours of operation (along with 5 years or 100,000 miles) for diesel engines. This addition is based on the Agency's determination that certain gasoline engines accumulate thousands of hours of engine operation before reaching either 5 years or 50,000 miles and that certain diesel engines accumulate thousands of hours of engine operation before reaching 5 years or 100,000 miles. Therefore, the only way to provide a reasonable period for the "useful life" warranties imposed by section

207 of the Clean Air Act is to include a provision for hours of operation in the useful definition.

b. A special test procedure for heavy duty military diesel engines which is designed to accommodate the unique design parameters and operating requirements of these engines.

A. Part 85 of Chapter I, Title 40 of the Code of Federal Regulations as applicable to 1973 and later model year heavy-duty engines is amended as follows, effective 30 days after publication in the FEDERAL REGISTER.

1. In § 85.1, paragraphs (a) (33) (ii) and (ii) are revised and a new subparagraph (37) is added, as follows:

§ 85.1 Definitions.

(a) * * *

(33) * * *

(ii) In the case of gasoline-fueled, heavy-duty engines, a period of use of 5 years or 50,000 miles of vehicle use or 1,500 hours of engine operation (or an equivalent period of 1,500 hours of dynamometer operation), whichever first occurs;

(iii) In the case of heavy-duty diesel engines, a period of use of 5 years or 100,000 miles of vehicle operation or 3,000 hours of engine operation (or an equivalent period of 1,000 hours of dynamometer operation), whichever first occurs.

(34) [Reserved]

(35) [Reserved]

(36) [Reserved]

(37) "Military engine" means any engine manufactured solely for the Department of Defense to meet military specifications.

2. In § 85.130, paragraphs (b) (2) and (c) are revised as follows:

§ 85.130 Test engines.

* * * * *

(b) * * *

(2) Engines of each engine family will be divided into groups based upon exhaust emission control system. Two engines of each engine-system combination shall be run for smoke emission data as prescribed in § 85.132(a). Within each combination, the engines that feature the highest fuel feed per stroke, primarily at the speed of maximum rated torque and secondarily at rated speed, will be selected. In the case where more than one engine in an engine-system combination have the highest fuel feed per stroke, the engine with the highest maximum rated torque will be selected. If there are military engines with higher fuel rates than other engines in the same engine-system combination, then two military engines with the highest fuel feed per stroke shall be also selected.

(c) Durability data engines:

(1) One engine from each engine-system combination shall be tested as prescribed in § 85.132(b). Within each combination, the engine which features the highest fuel feed per stroke, primarily at rated speed and secondarily at the speed of maximum rated torque, will be selected for durability testing. In the case where more than one engine in an engine-system combination have the highest fuel feed per stroke, the engine with the highest maximum rated horsepower will be selected for durability testing. If an engine-system combination includes both military and nonmilitary engines, then the nonmilitary engine with the highest maximum rated horsepower will be selected for durability testing.

(2) A manufacturer may select to operate and test additional engines to represent any engine-system combination. The additional engines must be of the same model and fuel system as the engine selected in accordance with the provisions of subparagraph (1) of this paragraph. Notice of an intent to test additional engines shall be given to the Administrator not later than 30 days following notification of the test fleet selection. Deterioration factors calculated for each engine-system combination shall be applied separately to military and nonmilitary engines within the same engine-system combination.

* * * * *

B. Part 85 of Chapter I, Title 40 of the Code of Federal Regulations as applicable to 1974 and later model year heavy-duty engines is amended as follows, effective 30 days after publication in the FEDERAL REGISTER:

1. In the Table of Contents, Subpart E is revised, the heading of Subpart J is revised, and Subpart K is added as follows:

Subpart E—Exhaust Emissions (Heavy-Duty Diesel Engines)

Sec.
85.40 Applicability.
85.41 Standards for exhaust smoke.
85.42 Standards for exhaust gaseous emissions.
85.43 Test procedures.

AUTHORITY: The provisions of this Subpart E issued under sec. 202 of the Clean Air Act, as amended, 42 U.S.C. 1857f–1 et seq.

* * * * *

Subpart J—Test Procedures for Engine Exhaust Smoke Emissions (Heavy-Duty Diesel Engines)

* * * * *

Subpart K—Test Procedures for Engine Exhaust Gaseous Emissions (Heavy-Duty Diesel Engines)

Sec.
85.140 Introduction.
85.141 Diesel fuel specifications.
85.142 Dynamometer procedure.
85.143 Dynamometer and engine equipment.
85.144 Sampling and analytical methods.
85.145 Information to be recorded.
85.146 Calibration and instrument check.
85.147 Test run.
85.148 Chart reading.
85.149 Calculations.
85.150 Test engines.
85.151 Service accumulation; emission measurements; maintenance.
85.152 Compliance with emission standards.

AUTHORITY: The provisions of this Subpart K issued under sec. 202 of the Clean Air Act, as amended, 42 U.S.C. 1857f–1 et seq.

2. In § 85.1, paragraphs (a) (29) and (33) are revised and new paragraphs (a) (34), (35), (36), and (37) are added, as follows:

§ 85.1 Definitions.

(a) * * *

(29) Zero (0) hours means that point after normal assembly line operations and adjustments and before one additional operating hour has been accumulated.

* * * * *

(33) "Useful life" means:

(i) In the case of light-duty vehicles, a period of use of 5 years of 50,000 miles, whichever first occurs;

(ii) In the case of gasoline fueled heavy-duty engines, a period of use of 5 years or 50,000 miles of vehicle use or 1,500 hours of engine operation (or an equivalent period of 1,500 hours of dynamometer operation), whichever first occurs;

(iii) In the case of heavy-duty diesel engines, a period of use of 5 years or 100,000 miles of vehicle operation or 3,000 hours of engine operation (or an equivalent period of 1,000 hours of dynamometer operation), whichever first occurs.

(34) "Peak torque speed" means the speed at which an engine develops maximum torque.

(35) "Percent load" means the fraction of the maximum available torque at an engine speed.

(36) "Intermediate speed" means the peak torque speed or 60 percent of rated speed, whichever is higher.

(37) "Military engine" means any engine manufactured solely for the Department of Defense to meet military specifications.

3. In § 85.2, eight new abbreviations are added as follows:

§ 85.2 Abbreviations.

* * * * *

BSCO—Brake specific carbon monoxide.
BSHC—Brake specific hydrocarbons.
$BSCO_x$—Brake specific oxides of nitrogen.
Exh.—Exhaust.
Hr.—Hour.
M—Mass.
WF—Weighting factor.
Σ—Summation.

4. In § 85.4, paragraphs (b) and (c) are revised and paragraph (e) is added as follows:

§ 85.4 Labeling.

* * * * *

(b) (1) The manufacturer of any heavy-duty, gasoline-fueled engine subject to any of the standards prescribed in this part shall, at the time of manufacture, affix a permanent, legible label, of the type and in the manner described below, containing the information hereinafter provided, to all production models of such engines available for sale to the public and covered by a certificate of conformity under § 85.55(a).

(2) The plastic or metal label shall be welded, bonded, or otherwise permanently attached to the engine in a position in which it will be readily visible after installation in the vehicle.

(3) The label shall be attached to an engine part necessary for normal engine operation and not normally requiring replacement during engine life.

(4) The label shall contain the following information lettered in the English language in block letters and numerals which shall be of a color that contrasts with the background of the label:

(i) The label heading: Engine Exhaust Emission Control Information;

(ii) Full corporate name and trademark of manufacturer;

(iii) Engine displacement (in cubic inches) and engine family identification;

(iv) Date of engine manufacture (month and year);

(v) Engine tuneup specifications and adjustments as recommended by the manufacturer, including idle speed, ignition timing, and the idle air-fuel mixture setting procedure and value (e.g., idle CO, idle air-fuel ratio, idle speed drop) and valve lash. These specifications should indicate the proper transmission position during tuneup and what accessories (e.g., air conditioner) if any, should be in operation;

(vi) The statement: "This Engine Conforms to U.S. Environmental Protection Agency Regulations Applicable to (insert current year) Model Year Gasoline-Fueled, Heavy-Duty Engines."

(c) (1) The manufacturer of any heavy-duty diesel engine subject to any of the standards prescribed in this part shall, at the time of manufacture, affix a permanent, legible label, of the type and in the manner described below, containing the information hereinafter provided, to all production models of such engines available for sale to the public and covered by a certificate of conformity under § 85.55(a).

(2) A plastic or metal label shall be welded, bonded, or otherwise permanently attached to the engine in a position in which it will be readily visible after installation in the vehicle.

(3) The label shall be attached to an engine part necessary for normal engine operation and not normally requiring replacement during engine life.

(4) The label shall contain the following information lettered in the English language in block letters and numerals which shall be of a color that contrasts with the background of the label:

(i) The label heading: Engine Exhaust Emission Control Information;

(ii) Full corporate name and trademark of manufacturer;

(iii) Engine family identification and model;

(iv) Date of engine manufacture (month and year);

(v) Engine specification:

Advertised horsepower_____at_____r.p.m.
Fuel rate at advertised horsepower_____ mm.³/stroke.
Valve lash_____(inches).
Initial injection timing (if adjustable)_____.

(The information applicable to each engine is to be inserted on the appropriate line.)

(vi) The statement: This Engine Conforms to U.S. Environmental Protection Agency Regulations Applicable to (insert current year) Model Year Heavy-Duty Diesel Engines.

* * * * *

(e) The label may be made up of one or more pieces provided that all pieces are permanently attached to the same engine or vehicle part as applicable.

5. Section 85.30 is revised to read as follows:

§ 85.30 Applicability.

The provisions of this subpart are applicable to new gasoline-fueled, heavy-duty engines beginning with the 1974 model year.

6. Section 85.31 is revised to read as follows:

§ 85.31 Standards for exhaust emissions.

(a) Exhaust emissions from new gasoline-fueled, heavy-duty engines shall not exceed:

(1) Hydrocarbons plus oxides of nitrogen (as NO_2)—16 grams per brake horsepower hour.

(2) Carbon monoxide—40 grams per brake horsepower hour.

(b) The standards set forth in paragraph (a) of this section refer to a composite sample representing the operating cycle set forth in the applicable sections of "Test Procedures for Engine Exhaust Emissions (Gasoline-fueled, Heavy-Duty Engines)" of this part and measured in accordance with those procedures.

7. Section 85.32 is revised to read as follows:

§ 85.32 Test procedures.

Every manufacturer of new motor vehicle engines subject to the standards prescribed in this subpart shall, prior to taking any of the actions specified in section 203(a)(1) of the Act, test or cause to be tested motor vehicle engines in accordance with test procedures prescribed in Subpart I of this part to ascertain that such test engines meet the requirements of § 85.31.

8. Subpart E is revised to read as follows:

Subpart E—Exhaust Emissions (Heavy-Duty Diesel Engines)

§ 85.40 Applicability.

The provisions of this subpart are applicable to new heavy-duty diesel engines beginning with the 1974 model year.

§ 85.41 Standards for exhaust smoke.

(a) The opacity of smoke emissions from new diesel engines subject to this subpart shall not exceed:

(1) 20 percent during the engine acceleration mode.

(2) 15 percent during the engine lugging mode.

(3) 50 percent during the peaks in either mode.

(b) The standards set forth in paragraph (a) of this section refer to exhaust smoke emissions generated under the conditions set forth in the "Test Procedures for Engine Exhaust Smoke Emissions (Heavy-Duty Diesel Engines)" of this part and measured and calculated in accordance with those procedures.

§ 85.42 Standards for exhaust gaseous emissions.

(a) Exhaust gaseous emissions from new heavy-duty diesel engines shall not exceed:

(1) Hydrocarbons plus oxides of nitrogen (as NO_2)—16 grams per brake horsepower hour.

(2) Carbon monoxide—40 grams per brake horsepower hour.

(b) The standards set forth in paragraph (a) of this section refer to exhaust gaseous emissions generated under the conditions set forth in the "Test Procedures for Engine Exhaust Gaseous Emissions (Heavy-Duty Diesel Engines)" of this part and measured and calculated in accordance with those procedures.

§ 85.43 Test procedures.

Every manufacturer of new motor vehicle engines subject to the standards prescribed in this subpart shall, prior to taking any of the actions specified in section 203(a)(1) of the Act, test or cause to be tested motor vehicle engines in accordance with test procedures prescribed in Subparts J and K of this part to ascertain that such test engines meet the requirements of §§ 85.41 and 85.42.

9. In § 85.100, paragraphs (b) and (c) are revised to read as follows:

§ 85.100 Introduction.

* * * * *

(b) The exhaust emission test is designed to determine hydrocarbon, carbon monoxide, and oxides of nitrogen concentrations during a truck driving pattern in a metropolitan area as simulated on an engine dynamometer. The test consists of two warmup cycles and two hot cycles. The average concentrations for the warmup cycles and the hot cycles are combined to yield the reported values.

(c) When an engine is tested for exhaust emissions or is operated for durability testing on an engine dynamometer the complete engine shall be used with all accessories which might reasonably be expected to influence emissions to the atmosphere installed and functioning. Evaporative emission controls need not be connected provided normal operating conditions are maintained in the engine induction system.

10. In § 85.102, paragraph (a)(1) is revised and a new paragraph (a)(4) is added as follows:

§ 85.102 Dynamometer operation cycle and equipment.

(a)(1) The following nine-mode cycle shall be followed in dynamometer operation tests of gasoline fueled heavy-duty engines.

Sequence No.	Mode	Manifold vacuum (in./hg.)	Time in mode-secs.	Cumulative time-secs.	Weighting factors
1	Idle		70	70	0.232
2	Cruise	16	23	93	.077
3	PTA	10	44	137	.147
4	Cruise	16	23	160	.077
5	PTD	19	17	177	.057
6	Cruise	16	23	200	.077
7	FL	3	34	234	.113
8	Cruise	16	23	257	.077
9	CT		43	300	.143

* * * * * * * *

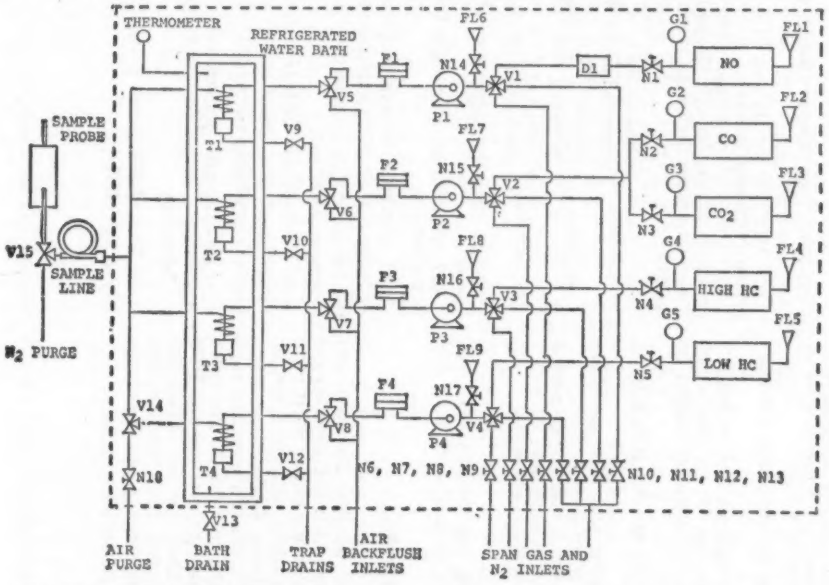
(4) If the specified manifold vacuum cannot be reached during the PTD mode, the engine shall be operated at closed throttle during that mode. If the specified manifold vacuum cannot be reached during the FL mode, the engine shall be operated at wide-open throttle during that mode.

* * * * *

11. In § 85.104, paragraphs (a) and (b) are revised, and paragraph (c) is revoked. As amended, § 85.104 reads as follows:

§ 85.104 Sampling and analytical system for measuring exhaust emissions.

(a) *Schematic drawing.* The following (fig. 6) is a schematic drawing of the exhaust gas sampling and analytical system which shall be used for testing under the regulations in this subpart.



(b) *Component description.* The following components shall be used in sampling and analytical systems for testing under the regulations in this part.

(1) Flowmeters FL1, FL2, FL3, FL4, and FL5 for indicating the sample flow rate through the analyzers.

(2) Nitric oxide NDIR analyzer.

(3) Carbon monoxide NDIR analyzer.

(4) Carbon dioxide NDIR analyzer.

(5) High-range hydrocarbon NDIR analyzer.

(6) Low-range hydrocarbon NDIR analyzer.

(7) Pressure gauges G1, G2, G3, G4, and G5 for indicating the analyzer sample pressure.

(8) Needle valves N1, N2, N3, N4, and N5 for regulating the sample flow rate to the analyzers.

(9) Drier D1 for removing water vapor from the sample.

(10) Needle valves N6, N7, N8, N9, N10, N11, N12, and N13 for regulating the flow rates of N_2 and span gases to the analyzers.

(11) Ball valves V1, V2, V3, and V4 for directing either sample or span gases to the analyzers.

(12) Needle valves N14, N15, N16, and N17 for regulating the sample flow rate through the bypass system.

(13) Flowmeters FL6, FL7, FL8, and FL9 for indicating the flow rate through the bypass system.

(14) Pumps P1, P2, P3, and P4 for forcing the samples through the analyzers.

(15) Filters F1, F2, F3, and F4 for removing contaminants from sample prior to analysis.

(16) Ball valves V5, V6, V7, and V8 for directing sample gas to the analyzers or for backflushing the sampling system with air or nitrogen.

(17) Toggle valves V9, V10, V11, V12, and V13 for draining the condensate traps and the refrigerated bath.

(18) Traps T1, T2, T3, and T4 for separating condensed water vapor from the cooled sample gases.

(19) Ball valve V14 for diverting air to the low-range hydrocarbon analyzer during periods of high hydrocarbon concentrations in the exhaust sample.

(20) Needle valve N18 for regulating the air flow to the low-range hydrocarbon analyzer during purge conditions.

(21) Thermometer for indicating the bath temperature.

(22) Refrigerated water bath for cooling the sample gases.

(23) Sample line for connecting the analysis system to the sample probe.

(24) Sample probe for extracting a sample of the exhaust downstream of the muffler.

(25) Ball valve V15 for directing nitrogen through the sampling system.

12. Section 85.105 is revised to read as follows:

§ 85.105 Information to be recorded.

The following information shall be recorded with respect to each test:

(a) Test number.

(b) System tested (brief description).

(c) Date and time of day for each part of the test schedule.

(d) Instrument operator.

(e) Driver or operator.

(f) Engine make—identification number—date of manufacture—number of hours—engine displacement—engine family—idle r.p.m.—number carburetors—number of carburetor venturis.

(g) All pertinent instrument information such as tuning—gain—serial numbers—detector numbers—range.

(h) Barometric pressure, intake air temperature and humidity and as applicable, the temperature of the air in front of the radiator during the test.

(i) Brake horsepower and fuel consumption.

(j) Analyzer responses, continuously recorded with zero, span and sample traces identified on each chart.

(k) Intake manifold vacuum and engine r.p.m. continuously recorded on the same chart with an automatic marker indicating 1-second intervals. Chart paper preprinted with 1-second intervals may be used in lieu of the automatic marker provided the use of the correct chart speed is verified on the chart for each test run.

13. In § 85.106, paragraphs (a) (2) and (3) and (b) (2) are revised to read as follows:

§ 85.106 Calibration and instrument checks.

(a) * * *

(2) Zero the analyzers with zero grade air or nitrogen. The allowable zero gas impurity concentrations should not exceed 10 p.p.m. equivalent carbon response, 10 p.p.m. carbon monoxide and 1 p.p.m. nitric oxide. Set the instrument gain to give the desired range. Normal operating ranges are as follows:

Low-range hydrocarbon analyzer.	–1,000 p.p.m. hexane equivalent.
High-range hydrocarbon analyzer.	0–1,000 p.p.m. hexane equivalent.
CO analyzer	0–10 percent CO.
CO_2 analyzer	0–16 percent CO.
NO analyzer	0–4,000 p.p.m. NO.

Lower operating ranges may be used as required.

(3) Calibrate with the following calibration gases. Flow rates should be set at 10 c.f.h. on the hydrocarbon and nitric oxide analyzers and 5 c.f.h. on the carbon monoxide and carbon dioxide analyzers. The concentrations given indicate nominal concentrations, and actual concentrations should be known to within ±2 percent of true value. Prepurified N_2 is used as the diluent.

Low range HC analyzer—hexane equivalent [1]	High range HC analyzer—hexane equivalent	NO analyzer—NO	CO and CO_2 analyzers—blend of CO and CO_2 containing—	
			CO	plus CO_2
p.p.m.:	*p.p.m.:*	*p.p.m.:*	*Mole percent*	*Mole percent*
100	600	250	0.5	16.0
200	1,000	500	1.0	15.0
300	1,500	750	2.0	14.0
400	2,500	1,000	3.0	13.0
600	4,000	1,500	4.0	12.0
800	6,000	2,000	6.0	10.0
1,000	8,000	2,500	8.0	8.0
-----	10,000	3,000	10.0	6.0
-----	-----	3,500	----	----
-----	-----	4,000	----	----

[1] The hexane equivalent of propane, when used as the normalizing gas for calibrating nondispersive infrared analyzers, is prescribed to be 0.52 (propane concentration×0.52=hexane equivalent concentration). Minimum storage temperature of the cylinders shall be 60° F.; minimum use temperature shall be 68° F.

* * * * *

(b) * * *

(2) Introduce the span gas and set the analyzer gain to match the response to the value indicated by the calibration curve. In order to avoid a correction for sample cell pressure, use the same flow rate as that used to calibrate the analyzer. The span gas should produce a signal from 80 to 100 percent of the full scale response. The concentration of the span gas should be known within ±2 percent of the actual gain. If gain has shifted by more than 3 percent of scale, check tuning. If necessary, check calibration. Recheck after test. Record actual concentrations on chart.

* * * * *

14. In § 85.107, paragraph (b) is revised to read as follows:

§ 85.107 Dynamometer test run.

* * * * *

(b) The following steps shall be taken for each test:

(1) Mount test engine on the engine dynamometer.

(2) Calibrate exhaust emission analyzer assembly.

(3) Check the condition of the drier in the nitric oxide analyzer sampling line. Replace the drying agent if necessary.

(4) Insert the sample line at least 2 feet into the tailpipe. When this is not possible, a tailpipe extension should be used.

(5) Start cooling system, if it is to be used.

(6) Start engine and idle at 1,000–1,200 r.p.m. for 5 minutes.

(7) Obtain normal idle speed, record it, and start exhaust sampling.

(8) Run four nine-mode cycles.

* * * * *

15. In § 85.108, paragraphs (a), (b), (c), and (e) are revised to read as follows:

§ 85.108 Chart reading.

* * * * *

(a) Determine whether the cycle was run in accordance with the specified cycle timing by observing either chart pips, speed trace, manifold vacuum trace, or concentration traces. Deviation by more than 2 seconds from the specified time for the CT mode, or deviation of more than 0.3" Hg during the cruise and PTD modes, or more than 0.2" Hg during the PTA and FL modes, from the specified mode vacuums during the last 10 seconds of a mode will invalidate the data.

(b) Time correlate the hydrocarbon, carbon monoxide, carbon dioxide, and nitric oxide charts. Determine the location on the chart of concentrations corresponding to each mode. Determine and compensate for trace abnormalities.

(c) For all open throttle (3 inches, 10 inches, 16 inches, and 19 inches Hg) and idle modes, average the last 3 seconds of the HC, CO, CO_2, and NO traces.

* * * * *

(e) Average the complete HC, CO, CO_2, and NO traces during the 43-second closed throttle mode of each cycle.

* * * * *

(1) $HC_{mass} = 10.8 \times 10^{-4} \times HC_{conc}$ (p.p.m.) $\times \frac{\text{Fuel consumption (gms./hr.)}}{TC}$

(2) $CO_{mass} = 2.02 \times CO_{conc}$ (percent) $\times \frac{\text{Fuel consumption (gms./hr.)}}{TC}$

(3) $NO_{x_{mass}} = 3.32 \times 10^{-4} \times NO_{conc}$ (p.p.m.) $\times \frac{\text{Fuel consumption (gms./hr.)}}{TC}$

(c) Multiply the HC_{mass}, CO_{mass}, and $NO_{x_{mass}}$ values for each mode by the appropriate weighting factors.

(d) Multiply the measured brake horsepower values for each mode by the appropriate weighting factors. (Negative values are not used.)

(e) Calculate the brake specific emissions for HC, CO, and NO_x for each cycle as follows:

(1) $BSHC = \frac{\Sigma(HC_{mass} \times WF)}{\Sigma(\text{measured BHP} \times WF)}$

(2) $BSCO = \frac{\Sigma(CO_{mass} \times WF)}{\Sigma(\text{measured BHP} \times WF)}$

(3) $BSNO_x = \frac{\Sigma(NO_{x_{mass}} \times WF)}{\Sigma(\text{measured BHP} \times WF)}$

(f) Average the composite BSHC, BSCO, $BSNO_x$ emissions of the first and second cycles.

(g) Average the composite BSHC, BSCO, and $BSNO_x$ emissions of the third and fourth cycles.

(h) Combine the results of paragraphs (f) and (g) of this section according to the formula: 0.35×composite of (f)+0.65×composite of (g).

(i) Correct the $BSNO_x$ value for the humidity at test conditions by multiplying by conversion factor "K" where:

$K = 0.634 + 0.00654H - 0.0000222H^2$

H=Humidity at test conditions, grain H_2O/lb. dry air.

17. In § 85.110, a new paragraph (f) is added as follows:

16. Section 85.109 is revised to read as follows:

§ 85.109 Calculations.

The final reported test results shall be derived through the following steps:

(a) Determine total carbon (TC) equivalent concentration in accordance with the following:

TC=percent CO_2+percent CO+(1.8×6) percent HC

(b) Calculate the mass emission for HC (HC mass), CO (CO mass), and NO_x (NO_x mass) in grants per hour for each mode as follows:

§ 85.110 Test engines.

* * * * *

(f) For purposes of testing under § 85.112(g), the Administrator may require additional emission data engines and durability data engines identical in all material respects to engines selected in accordance with paragraphs (b) and (c) of this section: *Provided*, That the number of engines selected shall not increase the size of either the emission data fleet or the durability data fleet by more than 20 percent or one engine whichever is greater.

18. In § 85.112, the first paragraph and paragraphs (a) and (b) are revised and a new paragraph (g) is added as follows:

§ 85.112 Service accumulation and emission measurements.

The engine dynamometer service accumulation schedule will consist of several operating conditions which give the same percentage of time at various manifold vacuums and the modes as specified in the emission test cycle. The average speed shall be between 1,650 and 1,700 r.p.m. Subject to the requirements as to average speed, there must be operation at speeds in excess of 3,200 r.p.m. (but not in excess of governed speed for governed engines or rated speed for nongoverned engines) for a cumulative maximum of 0.5 percent of the actual cycle time, excluding time in transient conditions. Maximum cycle time shall be 15 minutes. A cycle approved in advance by the Administrator shall be used.

(a) Emission data engines: Each emission data engine shall be operated for 125 hours with all emission control systems installed and operating. Emission tests shall be conducted at zero and 125 hours. Evaporative emission controls need not be connected provided normal operating conditions are maintained in the engine induction system.

(b) Durability data engines: Each durability data engine shall be operated, with all emission control systems installed and operating, for 1,500 hours. Emission measurements, as prescribed, shall be made at zero hours and at each 125-hour interval. Evaporative emission controls need not be connected provided normal operating conditions are maintained in the induction systems.

* * * * *

(g) (1) The Administrator may elect to operate and test any test engine during all or any part of the service accumulation and testing procedure. In such cases, the manufacturer shall provide the engine(s) to the Administrator with all information necessary to conduct the testing.

(2) The test procedures (§§ 85.101–85.109) will be followed by the Administrator. The Administrator will test the engines at each test point. Maintenance may be performed by the manufacturer under such conditions as the Administrator may prescribe.

(3) The data developed by the Administrator for the engine-system combination shall be combined with any applicable data supplied by the manufacturer on other engines of that combination to determine the applicable deterioration factors for the combination. In the case of a significant discrepancy between data developed by the Administrator and that submitted by the manufacturer, the Administrator's data shall be used in the determination of deterioration factors.

19. In § 85.113, paragraph (c) is revised to read as follows:

§ 85.113 Compliance with emission standards.

* * * * *

(c) The procedure for determining compliance of a new engine with exhaust emission standards is as follows:

(1) Separate emission deterioration factors shall be determined from the emission results of the durability data engines for each engine-system combination. Separate factors shall be established for CO and for the combined emissions of HC and NO_x.

(i) The applicable results to be used in determining the deterioration factors for each combination shall be:

(*a*) All emission data from the tests required under § 85.112(b), except the zero-hour tests. This shall include the official test results, as determined in § 85.54, for all tests conducted on all durability engines of the combination selected under § 85.110(c) (including all engines elected to be operated by the manufacturer under § 85.110(c)(3)).

(*b*) All emission data from the tests conducted before and after maintenance provided in § 85.111(a)(1)(i).

(ii) All applicable results shall be plotted as a function of the hours on the system, rounded to the nearest hour, and the best fit straight lines, fitted by the method of least squares, shall be drawn through these data points. The interpolated 125- and 1,500-hour points on this line must be within the standard provided in § 85.31 or the data shall not be used in calculation of a deterioration factor.

(iii) An exhaust emission deterioration factor shall be calculated for each combination as follows:

Factor = Exhaust emissions interpolated to 1,500 hours minus the exhaust emissions interpolated to 125 hours.

(2) The appropriate deterioration factor shall be added to the exhaust emission test results for each emission data engine: *Provided*, That if a deterioration factor as computed in subparagraph (1) of this paragraph is negative, that deterioration factor shall be zero when comparing adjusted emissions to the standards.

(3) The emissions to compare with the standard shall be the adjusted emissions of subparagraph (2) of this paragraph for each emission data engine.

(4) Every test engine of an engine family must comply with all applicable standards, as determined in subparagraph (3) of this paragraph, before any engine in that family will be certified.

20. The heading of Subpart J is revised to read as follows:

Subpart J—Test Procedures for Engine Exhaust Smoke Emissions (Heavy-Duty Diesel Engines).

21. In § 85.122, paragraph (a)(2)(ii) is revised to read as follows:

§ 85.122 Dynamometer operation cycle for smoke emission tests.

(a) * * *

(2) * * *

(ii) The engine shall be accelerated at full-throttle against the inertia of the engine and dynamometer or alternately against a preselected dynamometer load such that the engine speed reached 85 to 90 percent of rated speed in 5±1.5 seconds. This acceleration shall be linear within ±100 r.p.m.

* * * * *

22. In § 85.123, paragraph (c) is revised to read as follows:

§ 85.123 Dynamometer and engine equipment.

* * * * *

(c) A noninsulated exhaust system extending 15±5 feet from the exhaust manifold, or the crossover junction in the case of V engines, and presenting an exhaust back pressure within ±0.2 inch Hg of the upper limit at maximum rated horsepower, as established by the engine manufacturer in his sales and service literature for vehicle application. A conventional automotive muffler of a size and type commonly used with the engine being tested shall be employed in the exhaust system during smoke emission testing. The terminal 2 feet of the exhaust pipe shall be circular cross sectio and be free of elbows and bends. The end of the pipe shall be circular cross section and be inal 2 feet of the exhaust pipe shall have a diameter in accordance with the engine being tested, as specified below:

Maximum rated horsepower:	*Exhaust pipe diameter, inches*
Less than 101	2
101 to 200	3
201 to 300	4
301 or more	5

* * * * *

23. In § 85.124, paragraph (c) is revised to read as follows:

§ 85.124 Smoke measurement system.

* * * * *

(c) *Assembling equipment.* (1) The optical unit of the smokemeter shall be mounted radially to the exhaust pipe so that the measurement will be made at right angles to the axis of the exhaust plume. The distance from the optical centerline to the exhaust pipe outlet shall be 5±1 inch. The full flow of the exhaust stream shall be centered between the source and detector apertures (or windows and lenses) and on the axis of the light beam.

(2) Power shall be supplied to the control unit of the smokemeter in time to allow at least 15 minutes for stabilization prior to testing.

24. In § 85.126, paragraph (a)(3) is revised to read as follows:

§ 85.126 Instrument check.

(a) * * *

(3) Calibrated neutral density filters having approximately 10, 20, and 40 percent opacity shall be employed to check the linearity of the instrument. The filter(s) shall be inserted in the light path perpendicular to the axis of the beam and adjacent to the opening from which the beam of light from the light source

emanates, and the recorder response shall be noted. The nominal opacity value of the filter will be confirmed by the Administrator. Deviations in excess of 1 percent of the nominal opacity shall be corrected.

* * * * *

25. In § 85.127, paragraph (c)(8) is revised to read as follows:

§ 85.127 Test run.

* * * * *

(c) * * *

(8) During the test sequence of § 85.122, continuously record smoke measurements, engine r.p.m., and torque at a chart speed of 1 inch per minute minimum during the idle mode and transitional modes and 8 inches per minute minimum during the acceleration and lugging modes. The smokemeter zero and full scale recorder deflections may be rechecked during the idle mode of each test sequence. If either zero or full scale drift is in excess of 2 percent opacity, the smokemeter controls must be readjusted and the test must be repeated.

* * * * *

26. In § 85.128, a new paragraph (a)(4) is added as follows:

§ 85.128 Chart reading.

(a) * * *

(4) Examine the average one-half second values which were determined in subparagraphs (2) and (3) of this paragraph and record the three highest values for each dynamometer cycle.

27. In § 85.129, a new paragraph (c) is added as follows:

§ 85.129 Calculations.

* * * * *

(c) Average the nine readings in § 85.128(a)(4) and designate the value as "c".

28. In § 85.130, paragraphs (b) and (c) are revised and a new paragraph (f) is added as follows:

§ 85.130 Test engines.

* * * * *

(b) Emission data engines:

(1) Engines will be chosen to be run for emission data based upon engine family groupings. Within each engine family, the requirements of this paragraph must be met.

(2) Engines of each engine family will be divided into groups based upon exhaust emission control system. Two engines of each engine-system combination shall be run for smoke emission data as prescribed in § 85.132(a). Within each combination, the engines that feature the highest fuel feed per stroke, primarily at the speed of maximum rated torque and secondarily at rated speed, will be selected. In the case where more than one engine in an engine-system combination have the highest fuel feed per stroke, the engine with the highest maximum rated torque will be selected. If there are military engines with higher fuel rates than other engines in the same engine system combination, then two military engines with the highest fuel feed per stroke shall be also selected.

(c) Durability data engines:

(1) One engine from each engine-system combination shall be tested as prescribed in § 85.132(b). Within each combination, the engine which features the highest fuel feed per stroke, primarily at rated speed and secondarily at the speed of maximum rated torque, will be selected for durability testing. In the case where more than one engine in an engine-system combination has the highest fuel feed per stroke, the engine with the highest maximum rated horsepower will be selected for durability testing. If an engine system combination includes both military and nonmilitary engines, then the nonmilitary engine with the highest maximum rated horsepower will be selected for durability testing.

(2) A manufacturer may elect to operate and test additional engines to represent any engine-system combination. The additional engines must be of the same model and fuel system as the engine selected in accordance with the provisions of subparagraph (1) of this paragraph. Notice of an intent to test additional engines shall be given to the Administrator not later than 30 days following notification of the test fleet selection. Deterioration factors calculated for each engine-system combination shall be applied separately to military and nonmilitary engines within the same engine system combination.

* * * * *

(f) For purposes of testing under § 85.132(g), the Administrator may require additional emission data engines and durability data engines identical in all material respects to engines selected in accordance with paragraphs (b) and (c) of this section: *Provided*, That the number of engines selected shall not increase the size of either the emission data fleet or the durability data fleet by more than 20 percent or one engine, whichever is greater.

29. In § 85.132, paragraphs (a) and (b) are revised and new paragraphs (g) and (h) are added as follows:

§ 85.132 Service accumulation and emission measurements.

* * * * *

(a) *Emission data engines.* Each engine shall be operated on a dynamometer for 125 hours with the dynamometer and engine adjusted so that the engine is operating at 95–100 percent of rated speed and at least 95 percent of maximum rated horsepower. During such operation, the engine shall be run at the exhause back pressure specified in § 85.123(c) and the air inlet restriction specified in § 85.123(d) except that the tolerances shall be ±0.5 inch of Hg and ±3 inches of water respectively. Exhaust emission tests shall be conducted at zero and 125 hours of operation.

(b) *Durability data engines.* Each engine shall be operated on a dynamometer for 1,000 hours with the dynamometer and engine adjusted so that the engine is operating at 95–100 percent of rated speed and at least 95 percent of maximum rated horsepower. During such operation, the engine shall be run at the exhaust back pressure specified in § 85.123(c) and the air inlet restriction specified in § 85.123(d) except that the tolerances shall be ±0.5 inch of Hg and ±3 inches of water respectively. Exhaust emission measurements shall be made at zero hours and at each 125 hours of operation. All results except the zero hour results shall be used to establish the deterioration factors (see § 85.133).

* * * * *

(g) (1) The Administrator may elect to operate and test any test engine during all or any part of the service accumulation and testing procedure. In such cases, the manufacturer shall provide the engine(s) to the Administrator with all information necessary to conduct the testing.

(2) The test procedures (§§ 85.120–85.129) will be followed by the Administrator. The Administrator will test the engines at each test point. Maintenance may be performed by the manufacturer under such conditions as the Administrator may prescribe.

(3) The data developed by the Administrator for the engine-system combination shall be combined with any applicable data supplied by the manufacturer on other engines of that combination to determine the applicable deterioration factors for the combination. In the case of a significant discrepancy between data developed by the Administrator and that submitted by the manufacturer, the Administrator's data shall be used in the determination of deterioration factors.

(h) A break-in procedure, not to exceed 20 hours, may be run if approved in writing in advance by the Administrator. This procedure would be run after the 0 hour test; and the hours accumulated would not be counted as part of the service accumulation.

30. In § 85.133, paragraphs (c) (1) and (2) are revised to read as follows:

§ 85.133 Compliance with emission standards.

* * * * *

(c) The procedure for determining compliance with exhaust smoke emission standards in heavy-duty diesel engines is as follows:

(1) Emission deterioration factors for the acceleration mode (designated as "A"), the lugging mode (designated as "B"), and the peak opacity (designated as "C") shall be established separately for each engine-system combination.

(i) The applicable results to be used in determining the deterioration factors for each combination shall be:

(*a*) All emission data from the tests required under § 85.132(b), except the 0-hour tests. This shall include the official test results, as determined in § 85.54, for all tests conducted on all durability engines of the combination selected under § 85.130(c) (including all engines selected to be operated by the manufacturer under § 85.130(c)(2)).

(*b*) All emission data from the tests conducted before and after the maintenance provided in § 85.131(a)(1)(i).

(ii) All applicable results shall be plotted as a function of the hours on the sys-

tem, rounded to the nearest hour, and the best fit-straight lines, fitted by the method of least squares, shall be drawn through these data points. The interpolated 125- and 1,000-hour points on this line must be within the standard provided in § 85.41 or the data shall not be used in calculation of a deterioration factor.

(iii) The deterioration factors will be calculated as follows:

A—Percent opacity "a", interpolated to 1,000 hours, minus percent opacity "'a", interpolated to 125 hours.

B—Percent opacity "b", interpolated to 1,000 hours, minus percent opacity "b", interpolated to 125 hours.

C—Percent opacity "c", interpolated to 1,000 hours, minus percent opacity "c", interpolated to 125 hours.

(2) The "percent opacity" values to compare with the standards shall be the opacity values "a", "b", and "c" for each emission data engine within an engine-system combination to which are added the respective factors "A", "B", and "C" of subparagraph (1) of this paragraph for that engine-system combination: *Provided*, That if a deterioration factor as computed in subparagraph (1) of this paragraph is less than zero, that deterioration factor shall be zero for the purposes of this subparagraph.

* * * * *

31. A new subpart, Subpart K, is added as follows:

Subpart K—Test Procedures for Engine Exhaust Gaseous Emissions (Heavy-Duty Diesel Engines)

§ 85.140 Introduction.

(a) The procedures described in this subpart will be the test program to determine the conformity of heavy-duty diesel engines with the applicable standards set forth in this part.

(b) The test procedure begins with a warm engine and consists of a prescribed sequence of engine operating conditions on an engine dynamometer with continuous examination of the exhaust gases.

(c) The test is designed to determine the brake-specific emissions of hydrocarbons, carbon monoxide and oxides of nitrogen when an engine is operated through a cycle which consists of three idle modes and five power modes at each of two speeds which span the typical operating range of diesel engines. The procedure requires the determination of the concentration of each pollutant, the exhaust flow and the power output during each mode. The measured values are weighted and used to calculate the grams of each pollutant emitted per brake-horsepower hour.

(d) When an engine is tested for exhaust emissions or is operated for durability testing on an engine dynamometer the complete engine shall be used with all standard accessories which might reasonably be expected to influence emissions to the atmosphere installed and functioning.

§ 85.141 Diesel fuel specifications.

The requirements of § 85.121 shall be applicable to testing under this subpart.

§ 85.142 Dynamometer procedure.

(a) The following 13-mode cycle shall be followed in dynamometer operation tests of heavy-duty diesel engines:

Mode No.	Engine speed	Percent load
1	Low idle	0
2	Intermediate	2
3	....do	25
4	....do	50
5	....do	75
6	....do	100
7	Low idle	0
8	Rated	100
9	....do	75
10	....do	50
11	....do	25
12	....do	2
13	Low idle	0

(b) During each mode the specified speed shall be held to within 50 r.p.m. and the specified torque shall be held to within 2 percent of the maximum torque at the test speed. For example, the torque for mode 4 shall be between 48 and 52 percent of the maximum torque measured at the intermediate speed.

§ 85.143 Dynamometer and engine equipment.

The following equipment shall be used for emission testing of engines on engine dynamometers:

(a) An engine dynamometer with adequate characteristics to perform the test cycle described in § 85.142.

(b) An engine cooling system having sufficient capacity to maintain the engine at normal operating temperatures during conduct of the prescribed engine tests.

(c) A noninsulated exhaust system extending 15 ±5 feet from the exhaust manifold, or the crossover junction in the case of Vee engines, and presenting an exhaust black pressure within ±0.2 inch Hg of the upper limit at maximum rated horsepower, as established by the engine manufacturer in his sales and service literature for vehicle application. A conventional automotive muffler of a size and type commonly used with the engine being tested shall be employed in the exhaust system during emission testing.

(d) An engine air inlet system presenting an air inlet restriction within ±1 inch of water of the upper limit for the engine operating condition which results in maximum airflow, as established by the engine manufacturer in his sales and service literature, for the engine being tested.

§ 85.144 Sampling and analytical methods.

(a) The determination of the carbon monoxide and nitric oxide concentrations shall be accomplished using sampling and analysis components as specified in sections 2.1 and 2.2 of SAE Recommended Practice No. J177 titled, "Measurement of Carbon Dioxide, Carbon Monoxide and Oxides of Nitrogen in Diesel Exhaust," dated June 1970.

(b) The determination of the hydrocarbon concentrations shall be accomplished using sampling and analysis components as specified in sections 2.1 and 2.2 of SAE Recommended Practice No. J215 titled, "Continuous Hydrocarbon Analysis of Diesel Exhaust," dated November 1970.

(c) The determination of the intake airflow or exhaust flow shall be accomplished using SAE Recommended Practice No. J244 titled, "The Measurement of Intake or Exhaust Flow in Diesel Engines," dated May 1971.

§ 85.145 Information.

The following information shall be recorded:

(a) Test number.

(b) Date and time of day.

(c) Instrument operator.

(d) Engine operator.

(e) Engine identification numbers—date of manufacture—number of hours of operation accumulated on engine—engine family—exhaust pipe diameter—fuel injector type—low idel r.p.m., governed speed, maximum power and torque speeds—maximum horsepower and torque—fuel consumption at maximum power and torque—air aspiration system—exhaust system back pressure—air inlet restriction.

(f) All pertinent instrument information such as tuning—gain—serial numbers—detector numbers—range.

(g) Recorder chart. Identify zero traces—calibration or span traces—emission concentration traces for each test mode—start and finish of each test.

(h) Ambient temperature in dynamometer testing room.

(i) Engine intake air temperature and humidity for each mode.

(j) Barometric pressure.

(k) Observed engine torque for each mode.

(l) Intake airflow or exhaust flow for each mode.

(m) Fuel flow and temperature for each mode.

§ 85.146 Calibration and instrument checks.

Calibration and instrument checks shall be performed according to section 2.3.1 of SAE Recommended Practice No. J177, dated June 1970, and sections 3 and 7 of SAE Recommended Practice No. J215, dated November 1970, except that the instrument zeros need not be checked after each analysis but as necessary to maintain test validity. Calibration and checks of other instruments used for the test shall be performed as necessary according to good practice.

§ 85.147 Test run.

(a) The temperature of the air supplied to the engine shall be between 68° F. and 86° F. The fuel temperature at the pump inlet shall be 100° F. ±10° F. The observed barometric pressure shall be between 28.5 inches and 31 inches Hg. Higher air temperature or lower barometric pressure may be used, if desired, but no allowance shall be made for in-

creased emissions because of such conditions.

(b) The governor and fuel system shall have been adjusted to provide engine performance at the levels specified by the engine manufacturer for maximum rated horsepower and maximum rated torque. These specifications shall be reported in accordance with § 85.51 (b)(3).

(c) The following steps shall be taken for each test:

(1) Install instrumentation and sample probes as required.

(2) Start cooling system.

(3) Start the engine, warm it up and precondition it by running it at rated speed and maximum horsepower for 10 minutes or until all temperatures and pressures have reached equilibrium.

(4) Determine by experimentation the maximum torque at rated speed and intermediate speed to calculate the torque values for the specified test modes.

(5) Zero and span the emission analyzers.

(6) Start the test sequence of § 85.142. Operate the engine for 10 minutes in each mode, completing engine speed and load changes in the first minute. Record the responses of the analyzers on a strip chart recorder for the full 10 minutes with exhaust gas flowing through the analyzers at least during the last 5 minutes. Record the engine speed and load, intake air temperature and restriction, exhaust back pressure, fuel flow and air or exhaust flow during the last 5 minutes of each mode, making certain that the speed and load requirements of § 85.142 (b) are met during the last minute of each mode. Fuel flow during idle or 2 percent load conditions may be determined just prior to or immediately following the dynamometer sequence if longer times are required for accurate measurements.

(7) Read and record any additional data as required for § 85.145.

(8) Check and reset the zero and span settings of the emission analyzers as required but at least at the end of the second idle mode (mode No. 7) and at the end of the test. If a change of over 2 percent of full-scale response is observed, make necessary adjustments to the analyzers and repeat all test modes since the last zero and span check.

(9) Backflush condensate trap and replace filters as required.

§ 85.148 Chart reading.

(a) Locate the last 60 seconds of each mode and determine the average chart reading for HC, CO, and NO over the 1-minute period.

(b) Determine the concentration of HC, CO, NO during each mode from the average chart readings and the corresponding calibration data.

§ 85.149 Calculations.

The final reported test results shall be derived through the following steps:

(a) Determine the exhaust gas mass-flow rate for each mode according to the SAE Recommended Practice J244 dated May 1971.

(b) Convert the measured carbon monoxide and nitric oxide concentrations to a wet basis according to sections 4 and 5.4 of SAE Recommended Practice No. J177 (see § 85.144(a)).

(c) Multiply the corrected nitric oxide values by the following humidity correction factor.

$$\frac{1}{1-0.0025\ (H-75)}$$

Where H is the humidity of the inlet air measured as grains of H_2O per pound of dry air.

(d) Calculate the mass emissions of HC (HC mass), CO (CO mass), and NO_x (NO_x mass) in grams per hour for each mode as follows:

(1) $HC_{mass}=0.0132\times HC_{conc}\times$exhaust mass (lb./min.).

(2) $CO_{mass}=0.0263\times CO_{conc}\times$exhaust mass (lb./min.).

(3) $NO_{xmass}=0.0432\times NO_{conc}\times$exhaust mass (lb./min.).

(e) Calculate the weighted brake horsepower and HC, CO, and NO_x mass values as follows:

(1) Multiply the average of the three idle values by a weighting factor of 0.2.

(2) Multiply the values for all of the other modes by a weighting factor of 0.08.

(f) Calculate the brake specific emissions for HC, CO, and NO_x for each set of data as follows:

$$BSHC=\frac{\Sigma(HC_{mass}\times WF)}{\Sigma(\text{Measured BHP}\times WF)}$$

$$BSCO=\frac{\Sigma(CO_{mass}\times WF)}{\Sigma(\text{Measured BHP}\times WF)}$$

$$BSNO_x=\frac{\Sigma(NO_{xmass}\times WF)}{\Sigma(\text{Measured BHP}\times WF)}$$

§ 85.150 Test engines.

The test engines selected for testing under § 85.130 shall be used as the test engines for this subpart. The engines may be tested with the test procedure in Subpart J and the test procedure in this subpart consecutively at each test point irrespective of the requirements of §§ 85.132(b) and 85.151(a).

§ 85.151 Service accumulation; emission measurements; maintenance.

(a) Service accumulation and emission measurements shall be performed in accordance with the provisions of § 85.132.

(b) Maintenance on test engines shall be performed in accordance with the provisions of § 85.131.

§ 85.152 Compliance with emission standards.

(a) The exhaust gaseous emission standards in § 85.42 apply to the emissions of engines for their useful life.

(b) Since emission control efficiency decreases with the accumulation of hours on the engine, the emission level of an engine which has accumulated 1,000 hours of dynamometer operation will be used as the basis for determining compliance with the standards.

(c) The procedure for determining complance of a new engine with exhaust emission standards is as follows:

(1) Separate emission deterioration factors shall be determined from the emission results of the durability data engines for each engine-system combination. Separate factors shall be established for CO and for the combined emissions of HC and NO_x.

(i) The applicable results to be used in determining the deterioration factors for each combination shall be:

(*a*) All emission data from the tests required under § 85.132(b) except the zero-hour tests. This shall include the official test results, as determined in § 85.54 for all tests conducted on all durability engines of the combination selected under § 85.130(c) (including all engines selected to be operated by the manufacturer under § 85.130(c)(2)).

(*b*) All emission data from the tests conducted before and after the maintenance provided in § 85.131(a)(1)(i).

(ii) All applicable results shall be plotted as a function of the hours on the system, rounded to the nearest hour, and the best fit-straight lines, fitted by the method of least squares, shall be drawn through these data points. The interpointed 125- and 1,000-hour points on this line must be within the standard provided in § 85.42 or the data shall not be used in calculation of a deterioration factor.

(iii) An exhaust emission deterioration factor shall be calculated for each combination as follows:

Factor=Exhaust emissions interpolated to 1,000 hours minus the exhaust emissions interpolated to 125 hours.

(2) The appropriate deterioration factor shall be added to the exhaust emissions test results for each emissions data engine: *Provided*, That if a deterioration factor as computed in subparagraph (1) of this paragraph is negative, that deterioration factor shall be zero when comparing adjusted emissions to the standards.

(3) The emissions to compare with the standard shall be the adjusted emissions of subparagraph (2) of this paragraph for each emission data engine.

(4) Every test engine of an engine family must comply with all applicable standards, as determined in subparagraph (3) of this paragraph, before any engine in that family will be certified.

These regulations are published pursuant to section 202 of the Clean Air Act as amended, 42 U.S.C. 1857f–1 et seq.

Dated: August 30, 1972.

WILLIAM D. RUCKELSHAUS,
Administrator.

[FR Doc.72–15118 Filed 9–7–72;8:45 am]